REMARKS

Claims 1-17 and 19-24 are pending in the present application. In the Office Action mailed May 30, 2003, the Examiner objected to claims 16 and 17 for being unclear. The Examiner rejected claim 15 under 35 U.S.C. §102(b) as being anticipated by Takeshima (USP 4,219,863). The Examiner rejected claims 1-14 under 35 U.S.C. §103(a) as being unpatentable over Waring (USP 4,940,035) in view of Gully et al. (USP 5,032,772). Claims 15, 19, and 20-24 were rejected under 35 U.S.C. §103(a) as being unpatentable over Gladden (USP3,781,140) in view of Karsten et al. (USP 5,334,910). Claims 15 and 16-17 were rejected under 35 U.S.C. §103(a) as being unpatentable over Naoya (JP 07-109975) in view of Karsten et al.

The Examiner objected to claims 16 and 17 because the recitation "the permanent magnet" is not clear in the context. Applicant has amended claims 16 and 17 to call for "the pair of permanent magnets" as suggested by the Examiner. Applicant appreciates the Examiner's suggestion and respectfully requests that the objection to claims 16 and 17 be withdrawn.

The Examiner rejected claim 15 under 35 U.S.C. §102(b) as being anticipated by Takeshima. Applicant has amended claim 15 to better define the invention thereover. Claim 15 calls for, in part, the coil assembly being energizable upon application of alternating polarity signals to cause reciprocal movement of a drive member. Takeshima does not teach or suggest the use of alternating polarity signals. Takeshima teaches a reciprocal solenoid pump that energizes the solenoid to attract the core 8 to magnet 4 and to repel the core 8 by magnet 5. Col. 2, lns. 62-65. Then, "when the solenoid 1 is deenergized, the core 8 tends to maintain its position shown in Fig. 2b, but the spring 6 urges it downwardly toward the magnet, until it reaches a neutral position shown in Fig. 2c where the resilience of the springs 6, 7 is balanced." Col. 2, ln. 65-col. 3, ln. 2. Thus, Takeshima teaches energizing the coil to cause the core to move towards magnet 4 and deenergizing the coil to allow springs to return the core to a neutral position. Takeshima does not teach applying a signal of one polarity to move the core towards a magnet and applying a signal of opposite polarity to return the core to another position. As such, claim 15 is not anticipated by Takeshima, and Applicant respectfully requests that the rejection under 35 U.S.C. §102(b) be withdrawn.

The Examiner rejected claims 1-14 under 35 U.S.C. §103(a) as being unpatentable over Waring in view of Gully et al. Applicant disagrees with the Examiner that the differences between the subject matter sought to be patented and Waring and Gully et al. are such that the subject matter as a whole would have been obvious to a person having ordinary skill in the art to which said subject matter pertains.

Specifically, the Examiner states:

> Waring teaches a reciprocating fuel pump (column 3, lines 45-47) comprising: a housing assembly 21/8 including a drive section 21, a pump section 8 (see Figure 2) and a drive assembly 19/20/21 disposed in the drive section (see Figure 3). Waring further teaches said drive assembly includes a permanent magnet 21 (column 4, lines 2-3) and a coil assembly 20 having windings (column 4, lines 5-6) and disposed within a central volume of the drive section adjacent to the permanent magnet and movable reciprocally axially along a central axis. Waring further discloses a pumping member 17 secured to and movable reciprocally with the coil assembly, the pump member extending into the pump section to produce pressure variations in the pump section during reciprocal movement to draw fuel into the pump section and to express fuel therefrom (column 4, lines 40-45).

Thus, the Examiner indicates that some of the limitations of independent claims 1 and 8 are disclosed within Waring. Applicant however believes that the limitations in claims 1 and 8, as a whole, define over Waring and Gully et al. does not resolve the deficiency of claimed elements. While Waring teaches the use of no less than two pistons to make its variable flow rate pump, Applicant's invention utilizes only one piston for Applicant's pump.

Claim 1 calls for, in part, a drive section, a drive assembly, a coil assembly, and a pump member extending into the pump section to produce pressure variations in the pump section during reciprocal movement to draw fuel into the pump section and to express fuel therefrom. Claim 8 calls for, in part, a drive system, a coil assembly, a drive member, and a pump assembly, the drive member. However, as shown in Fig. 2, Waring at best teaches a fuel pump having two drive sections 21, two drive assemblies 19/20/21, two coil assemblies 20 having windings, and two pumping members 17 extending into the pump section to produce pressure variations in the pump section during reciprocal movement to draw fuel into the pump section and to express fuel therefrom. Essentially, Waring teaches two pumps that are each either on or off, that together can form a variable displacement pump; however, each of Waring's pumps is not a variable displacement pump. Thus, Applicant's invention, in part, calls for a drive section, a drive assembly, a coil assembly, and a pump member that imparts a force upon application of alternating polarity signals of variable amplitude to the winding, wherein the amplitude of the signals defines an amount of force imparted to draw fuel into the pump section and to express fuel therefrom; while Waring teaches two drive sections, two drive assemblies, two coil assemblies, two windings, and two pump members, that all together, may be controlled for variable displacement.

Waring further teaches that "[i]n broad terms the invention may be said to comprise a variable flow rate pump for fluid, comprising multiple electrically driven fluid delivery means

communicating to a common fluid outflow from the pump wherein the rate of fluid delivery of the pump is variable by varying the phase of operation of said fuel delivery means relative to one another." Col. 1, lns. 53-59. Waring also states that "[t]he electrically driven multiple fluid delivery means may comprise at least two pistons reciprocally movable independently of one another in fluid flow connected cylinders which are fluid flow connected with the pump outflow, and electromagnetic driving means associated with each piston." Col. 1, ln. 67 – col. 2, ln. 4.

Waring also claims at least two pistons in the two independent claims. Claim 1 of Waring calls for, in part, a pump comprising "at least two reciprocating fluid delivery mechanisms...." Col. 9, lns. 33-45. Claim 13 of Waring calls for, in part, a pump comprising "at least two pistons reciprocally movable independently of one another...." Col. 11, lns. 8-15.

Next, the Examiner states that Gully et al. discloses:

> controlling the length of the piston stroke and hence the volume rate of the pump by varying the amplitude of an alternating polarity input signal (column 3, lines 55-60). Fully et al. teach controlling the movement of the pump by varying the amplitude advantageously increased the efficiency of the unit (column 3, lines 25-33). Therefore, it would have been obvious to one of ordinary skill in the art, at the time the invention was made, to have used the amplitude control circuit taught by Gully et al., in the pump disclosed by Waring, to have advantageously increased the efficiency of the unit.

Applicant disagrees that one of ordinary skill in the art would have used the amplitude control circuit taught by Gully et al., in the pump disclosed by Waring, to have advantageously increased the efficiency of the unit, and even if one were so motivated, each Waring pump/piston configuration is a stop-to-stop displacement mechanism, meaning that each is either one or off -- it is only the combination of the two that allows for any variable displacement in Waring.

A *prima facie* case of obviousness has not been met because the Examiner's proposed combination of Waring and Gully et al. changes the principle of operation of the prior art invention being modified. *In re Ratti*, 270 F.2d 810 (CCPA 1959). Specifically, Gully et al. teaches "a direct current powered, linear resonant cryocooler having a compressor in which the piston is reciprocated by a linear motor at substantially resonant frequency and the length of stroke of the piston is varied as a direct function of cryocooler temperature." Abstract, lns. 1-5. Gully et al. teaches that "[e]fficiency is obtained by driving the moving parts of the compressor system, comprising the piston and the armature of the linear motor, at resonant frequency." Col. 3, lns. 30-33 (emphasis added). Further, Gully et al. states "[r]ather than change the compressor pumping frequency to achieve temperature control, as in rotary compressor coolers, this linear motor drive changes the length of the stroke of the piston of the compressor at constant

frequency, preferably at or near resonant frequency. This is the most efficient way because the cooler remains mechanically resonant." Col. 3, ln. 64-Col. 4, ln. 2 (emphasis added). Thus, Gully et al. teaches that the pumping frequency of the piston remains constant while the length of the stroke of the piston varies.

The teaching in Gully et al. that the pump piston remains at a constant pumping frequency so that efficiency is achieved is in contrast with Waring, which teaches the pumping frequency to vary with engine rotation frequency. Specifically, Waring states, "[t]he frequency of the driving currents provided to each piston/cylinder or equivalent arrangement should be the same, but where the pump is configured as a fuel injection pump it is possible for this frequency to be varied in synchronism with the engine rotation frequency, or in proportion to the engine rotation frequency, so that fuel delivery can be in phase with the opening sequence of the inlet valves of the engine." Col. 9, lns. 8-15. Thus, Waring teaches varying the frequency of the pump in synchronism with or proportion to the engine rotation frequency while Gully et al. teaches away from varying the pump frequency by keeping the pump frequency constant and varying the pump stroke.

Gully et al. does not teach or suggest varying the frequency of the pump piston. As described above, Gully et al. teaches away from varying the frequency of the piston. Thus, modifying the constant frequency pump piston of Gully et al. to vary the piston frequency so as to be in synchronism with the engine rotation frequency changes its principle operation. Therefore, a *prima facie* case of obviousness has not been met. Furthermore, one of ordinary skill in the art would not look to Gully et al. to combine a constant frequency, variable stroke pump with the two piston variable frequency pump as taught in Waring to increase efficiency.

Since Waring requires no less than two pistons to control fuel flow from a fuel pump and since claim 1 calls for a piston to control fuel flow from a fuel pump, in which a force is imparted upon application of alternating polarity signals of variable amplitude to the winding, wherein the amplitude of the signals defines an amount of force imparted in order to draw fuel into the pump section and to express fuel therefrom, claim 1 is believed to patentably define over Waring. It is noted that the claim requires application of alternating polarity signals of variable amplitude to the winding, the winding being a portion of the coil assembly, which in turn is a portion of the drive assembly which is one part of the claimed reciprocating fuel pump. This claim cannot be read on the multiple piston pump disclosed by Waring. Furthermore, since Gully et al. teaches away from varying the frequency of the piston, and the principle operation of the constant frequency pump piston changes when combined with Waring, a *prima facie* case of obviousness

has not been met. Therefore, Applicant respectfully requests that the rejection of claims 1 and 8 under 35 U.S.C. §103(a) be withdrawn.

Claims 2-7 and 9-14 were rejected under 35 U.S.C. §103(a) as being unpatentable over Waring in view of Gully et al. Applicant adopts the arguments set forth above with respect to Waring and Gully et al. Claims 2-7 depend, directly or indirectly, from independent claim 1 and claims 9-14 depend, directly or indirectly, from independent claim 8. Therefore, claims 2-7 and 9-14 are believed to be patentably distinct at least through the chain of dependency. Applicant respectfully requests that the rejection of claims 2-7 and 9-14 under 35 U.S.C. §103(a) be withdrawn.

The Examiner rejected claims 15 and 19-24 under 35 U.S.C. §103(a) as being unpatentable over Gladden in view of Karsten et al. Similar to Takeshima, Gladden does not teach applying a signal of varying polarities to a coil to cause reciprocal movement of a drive member.

Specifically, Gladden teaches an electrical pulse to energize a coil to cause a magnetic force to be exerted on the coil thereby moving a piston to compress fluid and store energy in a spring. *Abstract*, lns. 5-9; col. 2, lns. 16-20. The coil returns to its initial position under action of a spring, and "[n]o electrical current is supplied to the coil during the return cycle." *Abstract*, lns. 9-11; col. 2, lns. 24-27. Thus, Gladden teaches application of only one polarity signal to energize the coil and specifically teaches applying no electrical current to the coil during a return cycle.

Claim 15, however, calls for, in part, energizing a coil assembly upon application of alternating polarity signals to cause reciprocal movement of a drive member. The coil assembly is caused to reciprocate in one direction upon application of a signal of one polarity and in a second direction upon application of a signal of a second, alternating polarity.

The Examiner states that Gladden teaches most of the limitations of the claims, but Gladden does not teach a pair of permanent magnets. Karsten et al. teaches "two identically shaped semicircular magnets 50, 52 that when combined produce an annular shape." Col. 4, lns. 34-36. The Examiner states that it would have been obvious to one of ordinary skill in the art to have used the magnetic pair taught by Karsten et al., in the pump disclosed by Gladden, to have advantageously facilitated assembly of the unit.

Notwithstanding any advantage in assembly of the unit, the combination of Gladden and Karsten et al. fails to teach or suggest applying a signal of varying polarities to a coil to cause reciprocal movement of a drive member. As such, claim 15 is believed patentable over Gladden in view of Karsten et al.

Claims 19-24 depend, directly or indirectly, from independent claim 15 which is believed allowable. Therefore, claims 19-24 are also deemed allowable through the chain of dependency.

Next, the Examiner rejected claims 15-17 under 35 U.S.C. §103(a) as being unpatentable over Naoya in view of Karsten et al. The Examiner indicates that a combination of Naoya and Karsten et al. teaches limitations of the claims. As stated above, claim 15 has been amended to call for, in part, energizing a coil assembly upon application of alternating polarity signals to cause reciprocal movement of a drive member. Naoya teaches a piston 18 supported in a reciprocating movement form by resonance springs 20, 21. *See Abstract.* Resonance springs 20, 21 suggest that energy is stored in the springs upon a reciprocating movement of the piston 18 from an initial position to a second position upon application of current to the driving coil 16 to cause the piston 18 to return to the initial position when the current to the driving coil 16 is removed. It would not be obvious to one of ordinary skill in the art that Naoya teaches or suggests using alternating polarity signals to cause reciprocal movement of a drive member. As such, Applicant believes that claim 15 defines over Naoya in view of Karsten et al. since the combination of Naoya in view of Karsten et al. fails to teach or suggest applying an alternating polarity signal to a coil to cause reciprocal movement of a drive member.

Therefore, in light of the foregoing, Applicant respectfully believes that the present application is in condition for allowance. As a result, Applicant respectfully requests timely issuance of a Notice of Allowance for claims 1-17 and 19-24.

Applicant appreciates the Examiner's consideration of these Amendments and Remarks and cordially invites the Examiner to call the undersigned, should the Examiner consider any matters unresolved.

Respectfully submitted,

Timothy J. Ziolkowski
Registration No. 38,368
Direct Dial 262-376-5139
tjz@zpspatents.com

OFFICIAL

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P.O. ADDRESS:
Ziolkowski Patent Solutions Group, LLC
14135 North Cedarburg Road
Mequon, WI 53097-1416
262-376-5170